

Express Mail" label number: EV 318 175 195 US

Date of Deposit: November 19, 2003

PATENT
Case No. GP-304076
(2760/138)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
APPLICATION FOR UNITED STATES LETTERS PATENT

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TITLE: ESTABLISHING MOBILE TERMINATED
CONNECTIONS WITH DYNAMICALLY
ASSIGNED WIRELESS IP TERMINALS
IN AUTOMOTIVE TELEMATICS
APPLICATIONS

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ESTABLISHING MOBILE TERMINATED CONNECTIONS
WITH DYNAMICALLY ASSIGNED WIRELESS IP TERMINALS
IN AUTOMOTIVE TELEMATICS APPLICATIONS

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FIELD OF THE INVENTION

This invention relates generally to establishing internet connections
10 between a telematics unit and an internet provider. In particular, this invention
relates to a method for establishing mobile terminated connections with
dynamically assigned wireless IP terminals in automotive telematics applications.

BACKGROUND OF THE INVENTION

15 As Transmission Control Protocol/Internet Protocol (TCP/IP) (also referred to as packet data) connectivity over wireless wide area networks (WANs) continues to expand, mobile anytime, anywhere access to the Internet capabilities continue to become commonplace. The ability of such data transmission offers many advantages, including greater throughput and
20 standardized protocol architectures. In addition to mobile Internet access, packet data enables implementation of many applications. For example, automotive telematics enable applications that usually require large amounts of data to be transferred to or from the vehicle such as: navigation route data, downloading new applications, and remotely re-flashing of vehicle control modules.

25 Applications that utilize this TCP/IP connectivity in mobile vehicles are usually divided between two categories: Mobile Terminated (MT) and Mobile Originated (MO). Wireless packet data networks have been optimized for MO connections, due to a typical case of a user initiating a mobile connection from a mobile terminal.

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However, wireless packet data networks typically provide only a dynamically assigned IP address to the mobile terminal. This is a result of mobile users usually initiating only temporary connections to the Internet as well as limitations in current protocol standard (Ipv4) address space limit on the number of IP addresses available to wireless carriers. While static IP addresses may be allocated, they are usually costly and inefficient within the current framework.

These limitations present a problem for telematics applications that are initiated outside of the vehicle and require a mobile terminated connection. A factor affecting the viability of MT wireless packet data connectivity is that the physical medium for the data is wireless and not always available. A mobile terminal can only transmit TCP/IP data after the wireless carrier system has assigned specific physical channels for data transmission. After a period of inactivity the network may automatically reassign the channels to other packet data users and the terminal may fall into a dormant state where instantaneous data transfer is no longer possible and the terminal must again request resources for data transfer. Even when a terminal is assigned a static IP address, making a MT connection with that terminal while in a dormant state, where no physical radio channel is assigned for data transfer, is not always successful.

Accordingly, it would be desirable to have a method to establish mobile terminated connections to the Internet that overcomes the above disadvantages.

SUMMARY OF THE INVENTION

One aspect of the present invention provides a method for obtaining an internet connection. The method comprises sending an internet connection

- 5 request from a call center to a vehicle telematics unit and providing an IP address and server call in parameters to the vehicle telematics unit. The method further comprises receiving an internet connection at the provided IP address with the server call in parameters from the telematics unit at the call center.

Another aspect of the present invention provides a computer usable
10 medium including a computer readable program for obtaining an internet connection. The computer usable medium comprises computer readable program code for sending an internet connection request from a call center to a vehicle telematics unit and for providing an IP address and server call in parameters to the vehicle telematics unit. The computer usable medium also
15 comprises computer readable program code for receiving an internet connection at the provided IP address with the server call in parameters from the telematics unit at the call center.

Another aspect of the present invention provides a system for obtaining an internet connection. The system comprises means for sending an internet
20 connection request from a call center to a vehicle telematics unit and for providing an IP address and server call in parameters to the vehicle telematics unit. The system also provides means for receiving an internet connection at the provided IP address with the server call in parameters from the telematics unit at the call center.

25 The foregoing and other features and advantages of the invention will become further apparent from the following detailed description of the presently preferred embodiments, read in conjunction with the accompanying drawings. The detailed description and drawings are merely illustrative of the invention rather than limiting, the scope of the invention being defined by the appended
30 claims and equivalents thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

- FIG. 1** is a block diagram illustrating an operating environment in accordance with one embodiment of the present invention;
- 5 **FIG. 2** is a flow chart diagram of a general method for establishing mobile terminated connections with dynamically assigned wireless IP terminals in accordance with one embodiment of the present invention;
- 10 **FIG. 3** is a flow chart of one method of establishing a mobile terminated connection with dynamically assigned wireless IP terminals in automotive telematics applications in accordance with one embodiment of the present invention; and
- 15 **FIG. 4** is a flow chart of another method for establishing a mobile terminated connection with dynamically assigned wireless IP terminals in automotive telematics applications in accordance with one embodiment of the present invention.

DETAILED DESCRIPTION OF THE FIGURES

- FIG. 1** is an illustrative operating environment for an embodiment of the present invention. **FIG. 1** shows a mobile vehicle communication system **100**. Mobile vehicle communication system **100** includes mobile vehicle **110**, vehicle communication bus **112**, vehicle communications unit (VCU) **120**, one or more wireless carrier systems **140**, one or more communication networks **142**, one or more land networks **144**, one or more client, personal or user computers **150**, one or more web-hosting portals **160**, and one or more call centers **170**. In one embodiment, mobile vehicle **110** is implemented as a mobile vehicle equipped with suitable hardware and software for transmitting and receiving voice and data communications.

In an embodiment, VCU 120 is a telematics unit that includes a digital signal processor (DSP) 122 connected to a wireless modem 124, a global positioning system (GPS) unit 126, an in-vehicle memory 128, a microphone 130, 5 one or more speakers 132, an embedded or in-vehicle mobile phone 134, and a vehicle communications platform (VCP) 136. DSP 122 is also referred to as a microcontroller, controller, host processor, ASIC, or vehicle communications processor. GPS unit 126 provides longitude and latitude coordinates of the vehicle, as well as a time stamp and a date stamp. In-vehicle mobile phone 134 10 is a cellular-type phone, such as, for example an analog, digital, dual-mode, dual-band, multi-mode or multi-band cellular phone. In another example, the mobile telephone system is an analog mobile telephone system operating over a prescribed band nominally at 800 MHz. The mobile telephone system is a digital mobile telephone system operating over a prescribed band nominally at 800 15 MHz, 900 MHz, 1900 MHz, or any suitable band capable of carrying mobile communications. Examples of such digital mobile telephone systems include code division multiple access (CDMA) (e.g. IS-95), Global System for Mobile Communications (GSM), Frequency Division Multiple Access (FDMA), and time division multiple access (TDMA).

20 DSP 122 executes various computer programs that control programming and operational modes of electronic and mechanical systems within mobile vehicle 110. DSP 122 controls communications between VCU 120, wireless carrier system 140, and call center 170. In one embodiment, the DSP 122 manages communication channels and transmission of data through the VCP 25 136. In one embodiment, a speech-recognition application is installed in DSP 122 to translate human speech input through microphone 130 into digital signals. DSP 122 generates and accepts digital signals transmitted between VCU 120 and a vehicle communication bus 112 that is connected to various electronic modules in the vehicle 110. In one embodiment, the digital signals activate the

programming mode and operation modes, as well as provide for data transfers.

In this embodiment, signals from DSP 122 are translated into voice or speech messages and sent out through speaker 132.

- 5 Mobile vehicle 110, via a vehicle communication bus 112, sends signals to various units of equipment and systems within mobile vehicle 110 to perform various functions such as unlocking a door, opening the trunk, setting personal comfort settings, and calling from VCU 120. In facilitating interactions among the various communication and electronic modules, vehicle communication bus 112
- 10 utilizes bus interfaces such as controller-area network (CAN), International Organization for Standardization (ISO) Standard 9141, ISO Standard 11898 for high-speed applications, J1850, and ISO Standard 11519 for lower speed applications.

- 15 Mobile vehicle 110, via VCU 120, sends and receives radio transmissions from wireless carrier system 140. Mobile vehicle 110 may be in communication with one or more wireless carrier systems 140. Wireless carrier system 140 is implemented as any suitable system for transmitting a signal from mobile vehicle 110 to communication network 142. Wireless carrier system 140 incorporates any type of telecommunications in which electromagnetic waves carry signal over part of or the entire communication path. In one embodiment, wireless carrier system 140 transmits analog audio and/or video signals. In an example, wireless carrier system 140 transmits analog audio and/or video signals such as those sent from AM and FM radio stations and transmitters, or digital audio signals in the S band (approved for use in the U.S.) and L band (used in Europe and Canada). In one embodiment, wireless carrier system 140 is a satellite broadcast system broadcasting over a spectrum in the "S" band (2.3 GHz) that has been allocated by the U.S. Federal Communications Commission (FCC) for nationwide broadcasting of satellite-based Digital Audio Radio Service (DARS). In another example, wireless carrier system 140 includes a short message service, modeled after established protocols such as IS-637 SMS standards,
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IS-136 air interface standards for SMS, and GSM 03.40 and 09.02 standards. Similar to paging, an SMS communication could be broadcast to a number of regional recipients. In another example, the carrier uses services compliant with 5 other standards, such as, for example, IEEE 802.11 compliant systems, Bluetooth systems, and the like.

Communication network **142** includes services from one or more mobile telephone switching offices and wireless networks. Communication network **142** connects wireless carrier system **140** to land network **144**. Communication 10 network **142** is implemented as any suitable system or collection of systems for connecting wireless carrier system **140** to mobile vehicle **110** and land network **144**.

Land network **144** is a public-switched telephone network (PSTN). Mobile vehicle **110** may be in communication with one or more land networks **144**. In 15 one embodiment, land network **144** is implemented as an Internet protocol (IP) network. In other embodiments, land network **144** is implemented as a wired network, an optical network, a fiber network, another wireless network, or any combination thereof. Land network **144** is connected to one or more landline telephones. Land network **144** connects communication network **142** to user 20 computer **150**, web-hosting portal **160**, and call center **170**. Communication network **142** and land network **144** connects wireless carrier system **140** to web-hosting portal **160** and call center **170**.

Client, personal or user computer **150** includes a computer usable medium to execute Internet browser and Internet-access computer programs for 25 sending and receiving data over land network **144** and optionally, wired or wireless communication networks **142** to web-hosting portal **160**. Personal or user computer **150** sends data to web-hosting portal through a web-page interface using communication standards such as hypertext transport protocol (HTTP), and transport-control protocol Internet protocol (TCP/IP). In one 30 embodiment, the data includes vehicle data such as user preferences and

selections and operational modes of electronic and mechanical systems within mobile vehicle 110. In operation, a driver utilizes user computer 150 to initiate setting or re-setting of user-preferences for mobile vehicle 110. Various vehicle
5 data from client-side software is transmitted to server-side software of web-hosting portal 160. Other vehicle data is stored at web-hosting portal 160.

Web-hosting portal 160 includes one or more data modems 162, one or more web servers 164, one or more databases 166, and a network 168. Web-hosting portal 160 is connected, in one embodiment, directly by wire to call center 170, or connected by phone lines to land network 144, which is connected to call center 170. Web-hosting portal 160 is connected to land network 144 by one or more data modems 162. Land network 144 sends digital data to and from modem 162, and this data is subsequently transferred to web server 164. In one embodiment, modem 162 resides inside web server 164. Land network 144
10 transmits data communications between web-hosting portal 160 and call center 170.
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Web server 164 receives data from user computer 150 via land network 144. In alternative embodiments, user computer 150 includes a wireless modem to send vehicle data to web-hosting portal 160 through a wireless communication network 142 and a land network 144. Data is received by modem 162 and sent to one or more web servers 164. In one embodiment, web server 164 is implemented as any suitable hardware and software capable of providing web services to transmit and receive vehicle data from user computer 150 to VCU 120 in mobile vehicle 110. Web server 164 sends to or receives data
20 transmissions from one or more databases 166 via network 168. Web server 164 includes computer applications and files for managing vehicle data and generating targeted data.
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In one embodiment, one or more web servers **164** are networked via network **168** to distribute vehicle data among its network components such as database **166**. In an example, database **166** is a part of or a separate computer
5 from web server **164**. Web server **164** sends data transmissions to call center **170** via modem **162**, and through land network **144**.

Call center **170** is a location where many calls are received and serviced at the same time, or where many calls are sent at the same time. In one embodiment, the call center is a telematics call center, facilitating
10 communications to and from VCU **120** in mobile vehicle **110**. In an example, the call center is a voice call center, providing verbal communications between an advisor in the call center and a subscriber in a mobile vehicle. In another example, the call center contains each of these functions. In other embodiments, call center **170** and web-hosting portal **160** are located in the same or different
15 facilities.

Call center **170** contains one or more voice and data switches **172**, one or more communication services managers **174**, one or more communication services databases **176**, one or more communication services advisors **178**, and one or more network **180**.

20 Switch **172** of call center **170** connects to land network **144**. Switch **172** transmits voice or data transmissions from call center **170**, and receives voice or data transmissions from VCU **120** in mobile vehicle **110** through wireless carrier system **140**, communication network **142**, and land network **144**. Switch **172** receives data transmissions from and sends data transmissions to one or more
25 web-hosting portals **160**. Switch **172** receives data transmissions from or sends data transmissions to one or more communication services managers **174** via one or more network **180**.

- Communication services manager **174** is any suitable hardware and software capable of providing communication services to VCU **120** in mobile vehicle **110**. Communication services manager **174** sends to or receives data transmissions from one or more communication services databases **176** via network **180**. Communication services manager **174** sends to or receives data transmissions from one or more communication services advisors **178** via network **180**. Communication services database **176** sends to or receives data transmissions from communication services advisor **178** via network **180**.
- Communication services advisor **178** receives from or sends to switch **172** voice or data transmissions.

Communication services manager **174** facilitates one or more services, such as, but not limited to, enrollment services, navigation assistance, directory assistance, roadside assistance, business or residential assistance, information services assistance, emergency assistance, and communications assistance and vehicle data management services. Communication services manager **174** receives service requests for services from a user via user computer **150**, web-hosting portal **160**, and land network **144**. Communication services manager **174** transmits and receives vehicle data to VCU **120** in mobile vehicle **110** through wireless carrier system **140**, communication network **142**, land network **144**, voice and data switch **172**, and network **180**. Communication services manager **174** stores or retrieves vehicle data and information from communication services database **176**. Communication services manager **174** may provide requested information to communication services advisor **178**.

In one embodiment, communication services advisor **178** is a real advisor. In another embodiment, communication services advisor **178** is implemented as a virtual advisor. In an example, a real advisor is a human being at service provider service center in verbal communication with service subscriber in mobile vehicle **110** via VCU **120**. In another example, a virtual advisor is implemented as a synthesized voice interface responding to requests from VCU **120** in mobile vehicle **110**.

Communication services advisor **178** provides services to VCU **120** in mobile vehicle **110**. Services provided by communication services advisor **178** include enrollment services, navigation assistance, real-time traffic advisories, 5 directory assistance, roadside assistance, business or residential assistance, information services assistance, emergency assistance, and communications assistance. Communication services advisor **178** communicates with VCU **120** in mobile vehicle **110** through wireless carrier system **140**, communication network **142**, and land network **144** using voice transmissions, or through 10 communication services manager **174** and switch **172** using data transmissions. Switch **172** selects between voice transmissions and data transmissions.

Mobile vehicle **110** initiates service requests to call center **170** by sending a voice or digital-signal command to VCU **120** which in turn, sends an instructional signal or a voice call through wireless modem **124**, wireless carrier system **140**, communication network **142**, and land network **144** to call center 15 **170**. In another embodiment, the service request is for a vehicle data upload. In yet another embodiment, the mobile vehicle **110** receives a request from call center **170** to send various vehicle data from mobile vehicle **110** through VCU **120**, wireless modem **124**, wireless carrier system **140**, communication network **142**, and land network **144** to call center **170**. 20

FIG. 2 is a flow diagram of a general method for establishing mobile terminated connections with dynamically assigned wireless IP terminals for an embodiment of the present invention.

FIG. 2 shows a general method **200** for establishing a mobile terminated connection between a VCU **120** and a land network **144**. Land network **144** is preferably an Internet Protocol network, but any suitable network may be implemented. The method starts at block **210**.

Call center **170** issues a request for a wireless connection to be made between VCU **120** and land network **144** at block **220**. In one embodiment, the call center **170** requests an IP address and server call in parameters from IP network **144** through web portal **160**. In one embodiment, server call in parameters includes a TCP port number parameter, a connection failure timeout parameter, and a service type parameter. The TCP port number is a port number on web server **164**. Communication network **142** assigns dynamic IP addresses to terminals of mobile vehicles. The mobile vehicle's terminal is VCU **120**. The connection failure timeout parameter specifies how much time elapses during which no data transfer occurs in order for the wireless IP terminal to assume the connection has failed. The service type parameter describes what kind of service is requested. For example, this could be a request to download a certain update to an application, or a request to update a route. In one embodiment, call center **170** accesses land network **144** through web server **164**, which is controlled by call center **170** through web portal **160**. Call center **170** determines the IP address and server call in parameters through web server **164** in communication with land network **144**.

The call center **170** then sends the required IP address and server call in parameters and sends them to vehicle VCU **120** via wireless carrier system **140** at block **230**. Wireless carrier system **140** is any available wireless carrier system. In one embodiment, wireless carrier system **140** is a telephony network. In another embodiment, wireless carrier system **140** is an SMS network.

The vehicle communication system **120** receives the required parameters and IP address and establishes a TCP/IP connection to call center **170** through communication network **142** and land network **144**, using the provided parameters and IP address, at block **240**. In one embodiment, the VCU **120** terminates the connection to call center **170** after the IP address and parameters are received. The vehicle communication system then establishes a TCP/IP connection to a call center **170** server at the specified IP address. In another

embodiment, the VCU 120 does not terminate the connection to call center 170 after it has received the IP address and server call in parameters. Instead, a TCP/IP connection is established to the call center 170 server on another 5 channel in parallel with the connection to the call center 170.

After a TCP/IP connection has been established between the VCU 120 and call center 170, data transfer occurs at block 250. Data is transferred from the VCU 120 through land network 144 and vice versa via a wireless carrier system 140. The method stops at block 260.

10 It should be noted that communication network 142 and land network 144 do not know the IP address for the call center 170 server. Communication network 142 and land network 144 are pass-through networks.

15 FIG. 3 is a flow chart of one method of establishing a mobile terminated connection with dynamically assigned wireless IP terminals in automotive telematics applications.

FIG. 3 describes a method 300 for establishing a mobile terminated connection from an automotive telematics application when a preexisting connection between a call center 170 and VCU 120 is present. The method begins at block 310.

20 A preexisting connection between mobile vehicle 110 and call center 170 over wireless carrier system 140 exists at block 320. In one embodiment, the preexisting connection is a voice call over modem 124 between mobile vehicle 110 and advisor 178. Mobile vehicle 110 communicates with advisor 178 through the VCU 120. The VCU 120 comprises a telematics unit. Wireless 25 carrier system 140 comprises a telephony network or any wireless system capable of transmitting voice and data communications.

Call center **170** sends a request to web portal **160** for VCU **120** of mobile vehicle **110** to establish a connection to the land network **144** via a wireless carrier system **140** at block **330**. In the preferred embodiment, the land network **144** is an Internet Protocol network. The call center **170** requests for a dynamic IP address and server call in parameters be assigned to VCU **120** of mobile vehicle **110** by web server **164**. In one embodiment, web server **164** is controlled by call center **170**.

The call center **170** then directs vehicle VCU **120** to switch the wireless connection to modem **162** at block **340**. Call center **170** sends a request to the VCU **120** on the preestablished connection, which directs the VCU **120** to switch to a data session with modem **162** via wireless carrier system **140**.

Call center **170** then sends a request message to connect to the Internet, at block **350**, via a wireless carrier system **140**, to VCU **120**. In one embodiment, the request message includes a command for VCU **120** to establish a TCP/IP packet data connection to the Internet, an IP address, and server call in parameters. In a further embodiment, server call in parameters include a TCP port number, a connection failure timeout parameter, and a service type request. In a preferred embodiment, the wireless carrier system **140** comprises a telephony network. Wireless carrier system **140** can be used to take advantage of the preexisting connection between mobile vehicle **110** and call center **170**. In another embodiment, wireless carrier system **140** comprises an SMS network.

After receiving and running the request message, VCU **120** chooses at block **360** whether to terminate the call between VCU **120** and call center **170**. In one embodiment, VCU **120** terminates the connection between itself and call center **170** prior to establishing a TCP/IP connection to the call center **170**. In another embodiment, VCU **120** does not terminate the connection to call center **170**. Instead, VCU **120** opens up a separate connection to connect to the Internet using the IP address and server call in parameters described above.

VCU 120 establishes a packet data TCP/IP connection between itself and land network 144 at block 370. Land network 144 is, in one embodiment, an IP network. VCU 120 utilizes the received server call in parameters and IP address 5 to establish the connection. Server call in parameters and IP address can be used to connect to and log into web server 164.

After the establishment of a TCP/IP connection to the Internet, VCU 120 begins data transmission and reception at block 380. Data can be transmitted from the vehicle 110 to the Internet server 164 or vice versa. Therefore, though 10 the method 300 is originated outside of the mobile vehicle 110, the VCU 120 of the mobile vehicle 110 actually establishes the call to connect to the Internet. The method ends at block 390.

FIG. 4 is a flow chart of another method for establishing a mobile terminated connection with dynamically assigned wireless IP terminals in 15 automotive telematics applications in accordance with one embodiment of the present invention.

FIG. 4 shows a method 400 for establishing a mobile terminated connection from an automotive telematics application when no preexisting connection between a call center 170 and VCU 120 of mobile vehicle 110 is 20 present. The method begins at block 410 when a call center determines that a connection between land network 144 and mobile vehicle 110 is necessary. Land network 144 is, in one embodiment, an IP network.

Call center 170 sends a request, at block 420, to web portal 160, to provide connection parameters for a connection between VCU 120 of mobile 25 vehicle 110 and IP network 144 via a wireless carrier system 140. The call center 170 requests for a dynamic IP address and server call in parameters to be assigned to VCU 120 by web server 164. In one embodiment, web server 164 is controlled by call center 170.

Call center **170** then establishes a connection via a wireless carrier system **140** to VCU **120** at block **430**. In a preferred embodiment, the wireless carrier system **140** comprises an SMS network. SMS messages can be broadcast to mobile vehicle **110** without the need for a full two way connection. SMS network **140** can thus be used to benefit from not having to establish a full wireless connection between call center **170** and VCU **120**. In another embodiment, wireless carrier system **140** comprises a telephony network.

Call center **170** sends a request message, at block **440**, via wireless carrier system **140**, to VCU **120**. In one embodiment, the request message includes a command for VCU **120** to establish a TCP/IP packet data connection to the Internet, an IP address, and server call in parameters. In a further embodiment, server call in parameters include a TCP port number, a connection failure timeout parameter, and a service type request.

The request from the call center **170** is processed by the VCU **120** at block **450**. VCU **120** may already be engaged in communication via a wireless carrier system **140**. For example, the user may be utilizing mobile phone **134**, or may be connected to a different land network than the one specified for connection by the call center **170**. In one embodiment, server call in parameters and IP address are stored until the telematics unit becomes free to establish the requested connection to IP network **144**. In another embodiment, server call in parameters and IP address are utilized to establish a connection as soon as the request is received and other ongoing VCU **120** operations are suspended.

VCU **120** establishes a packet data TCP/IP connection between itself and land network **144** at block **460**. Land network **144** is preferably an Internet Protocol IP network. VCU **120** utilizes the received server call in parameters and IP address to establish the connection. Server call in parameters and IP address can be used to connect to and log onto the Internet through web server **164**. In one embodiment, VCU **120** terminates the connection between itself and call center **170** prior to establishing a TCP/IP connection to the Internet network **144**.

In another embodiment, VCU 120 does not terminate the connection to call center 170. Instead VCU 120 opens up a separate connection to connect to the Internet using the IP address and server call in parameters as described above.

- 5 After the establishment of a TCP/IP connection to the Internet, VCU 120 begins data transmission and reception at block 470. Data can be transmitted from the vehicle 110 to the Internet server 164 or vice versa. Therefore, though the method 400 is originated outside of the mobile vehicle 110, the VCU 120 of the mobile vehicle 110 actually establishes the call to connect to the Internet.
- 10 The method stops at block 480.

While the embodiments of the invention disclosed herein are presently considered to be preferred, various changes and modifications can be made without departing from the spirit and scope of the invention. The scope of the invention is indicated in the appended claims, and all changes that come within 15 the meaning and range of equivalents are intended to be embraced therein.